

# SEQUENCE LISTING

<110> The Scripps Research Institute  
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Cropp, T Ashton  
Anderson, J Christopher  
Schultz, Peter G

<120> EXPANDING THE EUKARYOTIC GENETIC CODE

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<160> 104

<170> PatentIn version 3.3

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gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360  
atgaatgtgc tgaccttcct gcgcgatatt ggcaaact tctccgtaa ccagatgac 420  
aaciaaagaag cgggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
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<210> 14  
<211> 540  
<212> DNA  
<213> artificial

<220>  
<223> artificial synthetase

<400> 14  
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gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180  
ggcggcgca cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240  
accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300  
gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360  
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aaciaaagaag cgggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
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<210> 15  
<211> 540

<212> DNA  
 <213> artificial  
  
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 <223> artificial synthetase  
  
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 ggcggcgcgga cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240  
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 gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360  
 atgaatgtgc tgaccttctt gcgcgatatt ggcaaact tctccgtaa ccagatgac 420  
 aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
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<210> 16  
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 <212> DNA  
 <213> artificial  
  
 <220>  
 <223> artificial synthetase  
  
 <400> 16  
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 ccgatcgac tctggtgtgg ctctgatact accgctgaca gcttgcattt ggggcatctt 120  
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 gatttcgact gtggagaaaa ctctgctatc gcggccaatt gttatgactg gttcggcaat 360  
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 aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
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<210> 17  
 <211> 624  
 <212> DNA  
 <213> artificial  
  
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 <223> artificial synthetase  
  
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gtgctgcaaa	ttgggtggtc	tgaccaatgg	ggtaacatca	cttctggtat	cgacctgacc	600
cgtcgtctgc	atcagaatca	ggtg				624

<210> 18  
 <211> 609  
 <212> DNA  
 <213> artificial

<220>  
 <223> artificial synthetase

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tgtggcttcg	atcctaccgc tgacagcttg catttggggc atcttgttcc attgttatgc 120
ctgaaacgct	tccagcaggc gggccacaag ccggttgccgc tggtaggcgg cgcgacgggt 180
ctgattggcg	acccgagctt caaagctgcc gagcgtaagc tgaacaccga agaaactggt 240
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ttcctgcgcg	atattggcaa acacttctcc gttaaccaga tgatcaacaa agaagcgggt 420
aagcagcgtc	tcaaccgtga agatcagggg atttcgttca ctgagttttc ctacaacctg 480
ctgcagggtt	atggttttgc ctgtttgaac aaacagtacg gtgtgggtgct gcaaattggg 540
ggttctgacc	agtggggtaa catcacttct ggtatcgacc tgacctgctg tctgcatcag 600
aatcaggtg	

<210> 19  
 <211> 591  
 <212> DNA  
 <213> artificial

<220>  
 <223> artificial synthetase

<400> 19	
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gctgacagct	tgcatttggg gcattctgtt ccattgttat gcctgaaacg cttccagcag 120

gcggggccaca agccggttgc gctggtaggc ggcgcgacgg gtctgattgg cgacccgagc	180
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atccgtaagc aggttgcccc gttcctcgat ttcgactgtg gagaaaactc tgctatcgcg	300
gccaataatt atgactgggtt cggcaatatg aatgtgctga ccttcctgcg cgatattggc	360
aaacacttct ccgttaacca gatgatcaac aaagaagcgg ttaagcagcg tctcaaccgt	420
gaagatcagg ggatttcggt cactgagttt tcctacaacc tgctgcaggg ttatggttat	480
gcctgtatga acaaacagta cgggtgtggtg ctgcaaattg gtggttctga ccagtggggg	540
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<210> 20  
 <211> 621  
 <212> DNA  
 <213> artificial

<220>  
 <223> artificial synthetase

<220>  
 <221> misc\_feature  
 <222> (26)..(26)  
 <223> n is a, c, g, or t

<220>  
 <221> misc\_feature  
 <222> (612)..(612)  
 <223> n is a, c, g, or t

<220>  
 <221> misc\_feature  
 <222> (618)..(618)  
 <223> n is a, c, g, or t

<400> 20	
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ccattgttat gcctgaaacg cttccagcag gcggggccaca agccggttgc gctggtaggc	180
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gaagaaactg ttcaggagtg ggtggacaaa atccgtaagc aggttgcccc gttcctcgat	300
ttcgactgtg gagaaaactc tgctatcgcg gccaataatt atgactgggt cggcaatatg	360
aatgtgctga ccttcctgcg cgatattggc aaacacttct ccgttaacca gatgatcaac	420
aaagaagcgg ttaagcagcg tctcaaccgt gaagatcagg ggatttcggt cactgagttt	480
tcctacaacc tgctgcaggg ttattctatg gcctgtgcga acaaacagta cgggtgtggtg	540
ctgcaaattg gtggttctga ccagtggggg aacatcactt ctggtatcga cctgacccgt	600
cgtctgcacg anaatcangt g	621

<210> 21  
 <211> 588  
 <212> DNA  
 <213> artificial  
  
 <220>  
 <223> artificial synthetase  
  
 <400> 21  
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 gacagcttgc atttggggca tcttggtcca ttgttatgcc tgaaacgctt ccagcaggcg 120  
 ggccacaagc cggttgcgct ggtaggcggc gcgacgggtc tgattggcga cccgagcttc 180  
 aaagctgccg agcgtaaact gaacaccgaa gaaactgttc aggagtgggt ggacaaaatc 240  
 cgtaagcagg ttgccccgtt cctcgatttc gactgtggag aaaactctgc tatcgcggcc 300  
 aataattatg actgggttcg caatatgaat gtgctgacct tcctgcgcga tattggcaaa 360  
 cacttctccg ttaaccagat gatcaacaaa gaagcgggta agcagcgtct caaccgtgaa 420  
 gatcagggga tttcggtcac tgagttttcc tacaacctgc tgcaggggta ttctgcggcc 480  
 tgtgcgaaca aacagtacgg tgtgggtgctg caaattgggtg gttctgacca gtggggtaac 540  
 atcacttctg gtatcgacct gaccgcgtct ctgcatcaga atcagggtg 588

<210> 22  
 <211> 600  
 <212> DNA  
 <213> artificial  
  
 <220>  
 <223> artificial synthetase

<220>  
 <221> misc\_feature  
 <222> (403)..(403)  
 <223> n is a, c, g, or t

<220>  
 <221> misc\_feature  
 <222> (513)..(513)  
 <223> n is a, c, g, or t

<220>  
 <221> misc\_feature  
 <222> (515)..(515)  
 <223> n is a, c, g, or t

<220>  
 <221> misc\_feature  
 <222> (518)..(518)  
 <223> n is a, c, g, or t

<220>  
 <221> misc\_feature  
 <222> (531)..(531)  
 <223> n is a, c, g, or t

<400> 22  
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ttccagcagg cgggccacaa gccggttgcg ctggtaggcg gcgcgacggg tctgattggc 180  
gacccgagct tcaaagctgc cgagcgtaag ctgaacaccg aagaaactgt tcaggagtgg 240  
gtggacaaaa tccgtaagca ggttgccccg ttctctgatt tcgactgtgg agaaaactct 300  
gctatcgcg ccaataatta tgactgggtc ggcaatatga atgtgctgac cttcctgcgc 360  
gatattggca aacacttctc cgtaaccag atgatcaaca aanaagcgg taagcagcgt 420  
ctcaaccgtg aagatcaggg gatttcgttc actgagtttt cctacaacct gctgcagggt 480  
tattcggctg cctgtgcgaa caaacagtac ggngngngnc tgcaaattgg nggttctgac 540  
caggggggta acatcacttc tggatcgac ctgaccgcgt gtctgcatca aaatcagggtg 600

<210> 23  
<211> 591  
<212> DNA  
<213> artificial

<220>  
<223> artificial synthetase

<220>  
<221> misc\_feature  
<222> (588)..(588)  
<223> n is a, c, g, or t

<400> 23  
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gcgggccaca agccggttgc gctggtaggc ggcgcgacgg gtctgattgg cgacccgagc 180  
ttcaaagctg ccgagcgtaa gctgaacacc gaagaaactg ttcaggagtg ggtggacaaa 240  
atccgtaagc aggttgcccc gttctctgat ttcgactgtg gagaaaactc tgctatcgcg 300  
gccaataatt atgactgggt cggcaatatg aatgtgctga cttcctgcgc cgatattggc 360  
aaacacttct ccgttaacca gatgatcaac aaagaagcgg ttaagcagcg tctcaaccgt 420  
gaagatcagg ggatttcgtt cactgagttt tcctacaacc tgctgcaggg ttatagtgcg 480  
gcctgtgtta acaaacagta cgggtgtgtg ctgcaaattg gtggttctga ccagtggggg 540  
aacatcactt ctggtatcga cctgaccgcgt cgtctgcatc agaatcangt g 591

<210> 24  
<211> 600  
<212> DNA  
<213> artificial

<220>  
<223> artificial synthetase

<400> 24  
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ttccagcagg cgggccacaa gccggttgcg ctggtaggcg gcgcgacggg tctgattggc 180  
gacccgagct tcaaagctgc cgagcgtaag ctgaacaccg aagaaactgt tcaggagtgg 240  
gtggacaaaa tccgtaagca ggttgccccg ttccctcgatt tcgactgtgg agaaaactct 300  
gctatcgcg ccaatgatta tgactgggtc ggcaatatga atgtgctgac cttcctgcgc 360  
gatattggca aacacttctc cgtaaccag atgatcaaca aagaagcggg taagcagcgt 420  
ctcaaccgtg aagatcaggg gatttcgttc actgagtttt cctacaacct gctgcagggt 480  
tataattttg cctgtgtgaa caaacagtac ggtgtggtgc tgcaaattgg tggttctgac 540  
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<210> 25  
<211> 579  
<212> DNA  
<213> artificial

<220>  
<223> artificial synthetase

<400> 25  
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ccggttgcg tggtaggcgg gcgcgacggg ctgattggcg acccgagctt caaagctgcc 180  
gagcgtaagc tgaacaccga agaaactgtt caggagtggg tggacaaaat ccgtaagcag 240  
gttgccccgt tcctcgattt cgactgtgga gaaaactctg ctatcgcggc caataattat 300  
gactgggttcg gcaatatgaa tgtgctgacc ttctgcgcgc atattggcaa acacttctcc 360  
gttaaccaga tgatcaacaa agaagcgggt aagcagcgtc tcaaccgtga agatcagggg 420  
atttcgttca ctgagttttc ctacaatctg ctgcagggtt attcggctgc ctgtcttaac 480  
aaacagtacg gtgtggtgct gcaaattggg ggttctgacc agtggggtaa catcacttct 540  
ggtatcgacc tgaccgcgc tctgcatcag aatcagggtg 579

<210> 26  
<211> 624  
<212> DNA  
<213> artificial

<220>  
<223> artificial synthetase

<220>  
<221> misc\_feature  
<222> (13)..(13)



<223> n is a, c, g, or t

<220>

<221> misc\_feature

<222> (599)..(599)

<223> n is a, c, g, or t

<400> 26

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ccgatcgac tcgggtgtgg ctctgatcct accgctgaca gcttgcatctt ggggcatctt	120
gttccattgt tatgcctgaa acgcttccag caggcggggc acaagccggt tgcgctggta	180
ggcggcgcgga cgggtctgat tggcgaccgg agcttcaaag ctgccgagcg taagctgaac	240
accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcagggttg cccgttcctc	300
gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat	360
atgaatgtgc tgaccttctt gcgcgatatt ggcaaact tctccgttaa ccagatgac	420
aacaaagaag cgggtaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag	480
ttttcctaca acctgctgca gggttattct atggcctgtt tgaacaaaca gtacggtgtg	540
gtgctgcaaa ttggtgggtc tgaccagtg ggtaacatca cttctggtat cgacctganc	600
cgctcgtctgc atcagaatca ggtg	624

<210> 27

<211> 625

<212> DNA

<213> artificial

<220>

<223> artificial synthetase

<220>

<221> misc\_feature

<222> (600)..(600)

<223> n is a, c, g, or t

<400> 27

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ccgatcgac tcacgtgtgg ctctgatcct accgctgaca gcttgcatctt ggggcatctt	120
gttccattgt tatgcctgaa acgcttccag caggcggggc acaagccggt tgcgctggta	180
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accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcagggttg cccgttcctc	300
gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat	360
atgaatgtgc tgaccttctt gcgcgatatt ggcaaact tctccgttaa ccagatgac	420
aacaaagaag cgggtaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag	480
ttttcctaca atctgctgca gggttattcg gctgcctgtc ttaacaaaca gtacggtgtg	540
gtgctgcaaa ttggtgggtc tgaccagtg ggtaacatca cttctggtat cgaacctgan	600

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625

<210> 28

<211> 624

<212> DNA

<213> artificial

<220>

<223> artificial synthetase

<400> 28

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gttcatttgt tatgcctgaa acgcttccag caggcaggcc acaagccggt tgcgctggta 180

ggcggcgca cggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360

atgaatgtgc tgaccttctt gcgcgatatt ggcaaacact tctccgtaa ccagatgac 420

aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480

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cgctcgtctg atcagaatca ggtg 624

<210> 29

<211> 624

<212> DNA

<213> artificial

<220>

<223> artificial synthetase

<400> 29

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ccgatcgac tcgctgtag cttcgatcct accgctgaca gcttgcatctt ggggcatctt 120

gttcatttgt tatgcctgaa acgcttccag caggcgggccc acaagccggt tgcgctggta 180

ggcggcgca cggtctgat tggcgacccg agcttcaagg ctgccgagcg taagctgaac 240

accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcaggttgc cccgttcctc 300

gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360

atgaatgtgc tgaccttctt gcgcgatatt ggcaaacact tctccgtaa ccagatgac 420

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gtgctgcaaa ttgggtggtc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600

cgtcgtctgc atcagaatca ggtg

624

<210> 30  
<211> 624  
<212> DNA  
<213> artificial

<220>  
<223> artificial synthetase

<400> 30  
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gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360  
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aacaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
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gtgctgcaaa ttggtggttc tgaccagtgg ggtaacatca cttctggtat cgacctgacc 600  
cgtcgtctgc atcagaatca ggtg 624

<210> 31  
<211> 624  
<212> DNA  
<213> artificial

<220>  
<223> artificial synthetase

<400> 31  
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gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180  
ggcggcgca cgggtctgat tggcgaccg agcttcaaag ctgccgagcg taagctgaac 240  
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gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360  
atgaatgtgc tgaccttct ggcgatatt ggcaaact tctccgtaa ccagatgac 420  
aacaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcgtgag 480  
ttttcctaca acctgctgca gggttatacg ttgcctgta tgaacaaaca gtacgggtgtg 540  
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 aaacgcttcc agcaggcggg ccacaagccg gttgcgctgg taggcggcgc gacgggtctg 180  
 attggcgacc cgagcttcaa agctgccgag cgtaagctga acaccgaaga aactgttcag 240  
 gagtgggtgg acaaaatccg taagcaggtt gccccgttcc tcgatttcga ctgtggagaa 300  
 aactctgcta tcgcggccaa taattatgac tggttcggca atatgaatgt gctgaccttc 360  
 ctgcgcgata ttggcaaaca cttctccgtt aaccagatga tcaacaaaga agcgggttaag 420  
 cagcgtctca accgtgaaga tcaggggatt tcgttactg agttttccta caatctgctg 480  
 caggggttatt cggctgcctg tcttaacaaa cagtacgggtg tgggtgctgca aattgggtgg 540  
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 gttccattgt tatgcctgaa acgcttccag caggcgggcc acaagccggt tgcgctggta 180  
 ggcggcgca cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240  
 accgaagaaa ctgttcagga gtgggtggac aaaatccgta agcagggtgc cccgttcctc 300  
 gatttcgact gtggagaaaa ctctgctatc gcggccaata attatgactg gttcggcaat 360  
 atgaatgtgc tgaccttctt gcgcgatatt ggcaaact tctccgttaa ccagatgac 420  
 aacaaagaag cgggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
 ttttctaca acctgctgca gggttattcg atggcctgta cgaacaaaca gtacgggtgtg 540  
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 gttccattgt tatgcctgaa acgcttccag caggcggggc acaagccggt tgcgctggta 180  
 ggcggcgca cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240  
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 atgaatgtgc tgaccttctt gcgcgatatt ggcaaact tctccgtaa ccagatgac 420  
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 gttccattgt tatgcctgaa acgcttccag caggcggggc acaagccggt tgcgctggta 180  
 ggcggcgca cgggtctgat tggcgacccg agcttcaaag ctgccgagcg taagctgaac 240  
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 atgaatgtgc tgaccttctt gcgcgatatt ggcaaact tctccgtaa ccagatgac 420  
 aacaaagaag cggttaagca gcgtctcaac cgtgaagatc aggggatttc gttcactgag 480  
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35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Ser Tyr Ala Cys Leu Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
Page 22

195	200	205
Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr 210 215 220		
Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu 225 230 235 240		
Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe 245 250 255		
Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu 260 265 270		
Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu 275 280 285		
Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala 290 295 300		
Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala 305 310 315 320		
Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser 325 330 335		
Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu 340 345 350		
Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu 355 360 365		
Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile 370 375 380		
Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu 385 390 395 400		
Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys 405 410 415		
Asn Tyr Cys Leu Ile Cys Trp Lys 420		

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<400> 37

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Pro Ile Ala Leu Ile Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Leu Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
Page 24





Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Ala Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
Page 26

290                      295                      300  
 Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305                      310                      315                      320  
 Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
                     325                      330                      335  
 Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
                     340                      345                      350  
 Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
                     355                      360                      365  
 Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
                     370                      375                      380  
 Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385                      390                      395                      400  
 Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
                     405                      410                      415  
 Asn Tyr Cys Leu Ile Cys Trp Lys  
                     420  
  
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                     20                      25                      30  
  
 Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
                     35                      40                      45  
  
 Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50                      55                      60  
  
 Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65                      70                      75                      80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Leu Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
Page 28

340                                      345                                      350  
 Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
           355                                      360                                      365  
 Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
           370                                      375                                      380  
 Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385                                      390                                      395                                      400  
 Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
                                     405                                      410                                      415  
 Asn Tyr Cys Leu Ile Cys Trp Lys  
                                     420

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                                     20                                      25                                      30  
 Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
                                     35                                      40                                      45  
 Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
                                     50                                      55                                      60  
 Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65                                      70                                      75                                      80  
 Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
                                     85                                      90                                      95  
 Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
                                     100                                      105                                      110  
 Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
                                     115                                      120                                      125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Thr Met Ala Cys Leu Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
Page 30

385                      390                      395                      400  
 Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
                          405                      410                      415  
 Asn Tyr Cys Leu Ile Cys Trp Lys  
                          420  
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 Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
                          20                      25                      30  
 Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
                          35                      40                      45  
 Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
                          50                      55                      60  
 Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65                      70                      75                      80  
 Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
                          85                      90                      95  
 Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
                          100                      105                      110  
 Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
                          115                      120                      125  
 Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
                          130                      135                      140  
 His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145                      150                      155                      160  
 Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
                          165                      170                      175

Leu Leu Gln Gly Tyr Thr Tyr Ala Cys Leu Asn Lys Gln Tyr Gly Val  
 180 185 190  
 Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205  
 Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220  
 Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240  
 Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255  
 Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270  
 Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285  
 Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300  
 Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320  
 Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335  
 Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350  
 Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365  
 Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380  
 Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400  
 Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415  
 Asn Tyr Cys Leu Ile Cys Trp Lys  
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<223> artificial synthetase

<400> 42

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Pro Ile Ala Leu Leu Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Ser Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
420

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<400> 43

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
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Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
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Pro Ile Ala Leu Leu Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Ala Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
420

<210> 44  
<211> 424  
<212> PRT  
<213> artificial

<220>  
<223> artificial synthetase

<400> 44

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
20 25 30

Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Arg Met Ala Cys Leu Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
420

<210> 45

<211> 424

<212> PRT

<213> artificial

<220>

<223> artificial synthetase

<400> 45

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
20 25 30

Pro Ile Ala Leu Ile Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Gly Met Ala Cys Ala Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 46

<211> 424

<212> PRT

<213> artificial

<220>

<223> artificial synthetase

<400> 46

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Gly Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160



Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Gly Phe Ala Cys Ala Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
420

<210> 47  
<211> 424  
<212> PRT  
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<220>  
<223> artificial synthetase

<400> 47

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
20 25 30

Pro Ile Ala Leu Gly Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Gly Tyr Ala Cys Met Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220  
 Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240  
 Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255  
 Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270  
 Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285  
 Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300  
 Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320  
 Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335  
 Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350  
 Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365  
 Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380  
 Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400  
 Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415  
 Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 48  
 <211> 424  
 <212> PRT  
 <213> artificial  
 <220>  
 <223> artificial synthetase

<400> 48

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
20 25 30

Pro Ile Ala Leu Leu Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Ala Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
420

<210> 49  
<211> 424  
<212> PRT  
<213> artificial

<220>  
<223> artificial synthetase

<400> 49

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
20 25 30

Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Ala Ala Cys Ala Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
420

<210> 50  
<211> 424  
<212> PRT  
<213> artificial

<220>  
<223> artificial synthetase

<400> 50

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
20 25 30

Pro Ile Ala Leu Leu Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Ala Ala Cys Ala Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350



Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
420

<210> 51  
<211> 424  
<212> PRT  
<213> artificial

<220>  
<223> artificial synthetase

<400> 51

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
20 25 30

Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Ser Ala Ala Cys Val Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
 225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
 245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
 275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
 290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
 405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
 420

<210> 52  
 <211> 424  
 <212> PRT  
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<220>  
 <223> artificial synthetase

<400> 52

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
 1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
 20 25 30

Pro Ile Ala Leu Ile Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
 50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asp Tyr Asp  
 115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Asn Phe Ala Cys Val Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
385 390 395 400

Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
405 410 415

Asn Tyr Cys Leu Ile Cys Trp Lys  
420

<210> 53  
<211> 424  
<212> PRT

<213> artificial

<220>

<223> artificial synthetase

<400> 53

Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
1 5 10 15

Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
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Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
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Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Ser Ala Ala Cys Leu Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
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Asn Tyr Cys Leu Ile Cys Trp Lys  
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Met Ala Ser Ser Asn Leu Ile Lys Gln Leu Gln Glu Arg Gly Leu Val  
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Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
Page 54

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Pro Ile Ala Leu Gly Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His		
35	40	45
Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala		
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Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly		
65	70	75
Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr		
85	90	95
Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu		
100	105	110
Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp		
115	120	125
Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys		
130	135	140
His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg		
145	150	155
Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn		
165	170	175
Leu Leu Gln Gly Tyr Ser Met Ala Cys Leu Asn Lys Gln Tyr Gly Val		
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Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly		
195	200	205
Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr		
210	215	220
Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu		
225	230	235
Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe		
245	250	255
Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu		
260	265	270
Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu		
275	280	285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
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Asn Tyr Cys Leu Ile Cys Trp Lys  
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Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
Page 56



65	70	75	80
Asp Pro Ser Phe	Lys 85 Ala Ala Glu	Arg Lys 90 Leu Asn Thr	Glu 95 Glu Thr
Val Gln Glu Trp	Val 100 Asp Lys Ile	Arg 105 Lys Gln Val	Ala 110 Pro Phe Leu
Asp Phe Asp	Cys 115 Gly Glu Asn	Ser 120 Ala Ile Ala	Asn 125 Asn Tyr Asp
Trp Phe Gly	Asn 130 Met Asn Val	Leu 135 Thr Phe Leu	Arg 140 Asp Ile Gly Lys
His Phe Ser Val	Asn 150 Gln Met Ile	Asn 155 Lys Glu Ala	Val 160 Lys Gln Arg
Leu Asn Arg Glu	Asp 165 Gln Gly Ile	Ser 170 Phe Thr Glu	Phe 175 Ser Tyr Asn
Leu Leu Gln Gly	Tyr 180 Ser Ala Ala	Cys 185 Leu Asn Lys	Gln 190 Tyr Gly Val
Val Leu Gln Ile	Gly 195 Gly Ser Asp	Gln 200 Trp Gly Asn	Ile 205 Thr Ser Gly
Ile Asp Leu Thr	Arg 210 Arg Leu His	Gln 215 Asn Gln Val	Phe 220 Gly Leu Thr
Val Pro Leu Ile	Thr 225 Lys Ala Asp	Gly 230 Thr Lys Phe	Gly 235 Lys Thr Glu
Gly Gly Ala Val	Trp 245 Leu Asp Pro	Lys 250 Lys Thr Ser	Pro 255 Tyr Lys Phe
Tyr Gln Phe Trp	Ile 260 Asn Thr Ala	Asp 265 Ala Asp Val	Tyr 270 Arg Phe Leu
Lys Phe Phe Thr	Phe 275 Met Ser Ile	Glu 280 Glu Ile Asn	Ala 285 Leu Glu Glu
Glu Asp Lys Asn	Ser 290 Gly Lys Ala	Pro 295 Arg Ala Gln	Tyr 300 Val Leu Ala
Glu Gln Val Thr	Arg 305 Leu Val His	Gly 310 Glu Glu Gly	Leu 315 Gln Ala Ala
Lys Arg Ile Thr	Glu 325 Cys Leu Phe	Ser 330 Gly Ser Leu	Ser 335 Ala Leu Ser

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
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Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
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Asn Tyr Cys Leu Ile Cys Trp Lys  
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Pro Ile Ala Leu Ser Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
50 55 60

Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
Page 58

115

120

125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
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Leu Leu Gln Gly Tyr Thr Met Ala Cys Val Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
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Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
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Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
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Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
 260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
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Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
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Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
 305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
 325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
 340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
 355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
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Asn Tyr Cys Leu Ile Cys Trp Lys  
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Pro Ile Ala Leu Ala Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
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Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
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Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
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Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
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Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn

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Leu	Leu	Gln	Gly 180	Tyr	Ser	Tyr	Ala	Cys 185	Leu	Asn	Lys	Gln	Tyr 190	Gly	Val
Val	Leu	Gln 195	Ile	Gly	Gly	Ser	Asp 200	Gln	Trp	Gly	Asn	Ile 205	Thr	Ser	Gly
Ile	Asp 210	Leu	Thr	Arg	Arg	Leu 215	His	Gln	Asn	Gln	Val 220	Phe	Gly	Leu	Thr
Val 225	Pro	Leu	Ile	Thr	Lys 230	Ala	Asp	Gly	Thr	Lys 235	Phe	Gly	Lys	Thr	Glu 240
Gly	Gly	Ala	Val	Trp 245	Leu	Asp	Pro	Lys	Lys 250	Thr	Ser	Pro	Tyr	Lys 255	Phe
Tyr	Gln	Phe	Trp 260	Ile	Asn	Thr	Ala	Asp 265	Ala	Asp	Val	Tyr	Arg 270	Phe	Leu
Lys	Phe	Phe 275	Thr	Phe	Met	Ser	Ile 280	Glu	Glu	Ile	Asn	Ala 285	Leu	Glu	Glu
Glu	Asp 290	Lys	Asn	Ser	Gly	Lys 295	Ala	Pro	Arg	Ala	Gln 300	Tyr	Val	Leu	Ala
Glu 305	Gln	Val	Thr	Arg	Leu 310	Val	His	Gly	Glu	Glu 315	Gly	Leu	Gln	Ala	Ala 320
Lys	Arg	Ile	Thr	Glu 325	Cys	Leu	Phe	Ser	Gly 330	Ser	Leu	Ser	Ala	Leu 335	Ser
Glu	Ala	Asp	Phe 340	Glu	Gln	Leu	Ala	Gln 345	Asp	Gly	Val	Pro	Met 350	Val	Glu
Met	Glu	Lys 355	Gly	Ala	Asp	Leu	Met 360	Gln	Ala	Leu	Val	Asp 365	Ser	Glu	Leu
Gln	Pro 370	Ser	Arg	Gly	Gln	Ala 375	Arg	Lys	Thr	Ile	Ala 380	Ser	Asn	Ala	Ile
Thr 385	Ile	Asn	Gly	Glu	Lys 390	Gln	Ser	Asp	Pro	Glu 395	Tyr	Phe	Phe	Lys	Glu 400
Glu	Asp	Arg	Leu	Phe 405	Gly	Arg	Phe	Thr	Leu 410	Leu	Arg	Arg	Gly	Lys 415	Lys
Asn	Tyr	Cys	Leu 420	Ile	Cys	Trp	Lys								

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Pro Ile Ala Leu Ala Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
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Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
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Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
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Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
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Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
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Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
 165 170 175

Leu Leu Gln Gly Tyr Thr Met Ala Cys Cys Asn Lys Gln Tyr Gly Val  
 180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
 195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
 Page 62

210	215	220
Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu		
225	230	235 240
Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe		
	245	250 255
Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu		
	260	265 270
Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu		
	275	280 285
Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala		
	290	295 300
Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala		
305	310	315 320
Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser		
	325	330 335
Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu		
	340	345 350
Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu		
	355	360 365
Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile		
	370	375 380
Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu		
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Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys		
	405	410 415
Asn Tyr Cys Leu Ile Cys Trp Lys		
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Pro Ile Ala Leu Thr Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
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Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
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Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
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Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Thr Phe Ala Cys Met Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
Page 64



260	265	270
Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu 275 280 285		
Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala 290 295 300		
Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala 305 310 315 320		
Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser 325 330 335		
Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu 340 345 350		
Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu 355 360 365		
Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile 370 375 380		
Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu 385 390 395 400		
Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys 405 410 415		
Asn Tyr Cys Leu Ile Cys Trp Lys 420		
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Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly 20 25 30		
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Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
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Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
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Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
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Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Ser Val Ala Cys Leu Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
Page 66

305                      310                      315                      320  
 Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
                                  325                                   330                                   335  
 Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
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 Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
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 Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
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 Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
 385                                   390                                   395                                   400  
 Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
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 Asn Tyr Cys Leu Ile Cys Trp Lys  
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 Ala Gln Val Thr Asp Glu Glu Ala Leu Ala Glu Arg Leu Ala Gln Gly  
                                  20                                   25                                   30  
 Pro Ile Ala Leu Val Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
                                  35                                   40                                   45  
 Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
                                  50                                   55                                   60  
 Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65                                   70                                   75                                   80  
 Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
                                  85                                   90                                   95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
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Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
115 120 125

Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
165 170 175

Leu Leu Gln Gly Tyr Ser Met Ala Cys Thr Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
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Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
210 215 220

Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
260 265 270

Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
275 280 285

Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
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Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
305 310 315 320

Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
340 345 350

Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu

355

360

365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
 370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
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Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
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Asn Tyr Cys Leu Ile Cys Trp Lys  
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Pro Ile Ala Leu Ser Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
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Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
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Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
 85 90 95

Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
 100 105 110

Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
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Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
 130 135 140

His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
145 150 155 160

Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
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Leu Leu Gln Gly Tyr Ser Phe Ala Cys Leu Asn Lys Gln Tyr Gly Val  
180 185 190

Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
195 200 205

Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
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Val Pro Leu Ile Thr Lys Ala Asp Gly Thr Lys Phe Gly Lys Thr Glu  
225 230 235 240

Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
245 250 255

Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
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Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
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Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

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Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
325 330 335

Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
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Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
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Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
370 375 380

Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
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Glu Asp Arg Leu Phe Gly Arg Phe Thr Leu Leu Arg Arg Gly Lys Lys  
Page 70

405

410

415

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Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
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Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
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Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
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Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
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Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
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His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
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Leu Asn Arg Glu Asp Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
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Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
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Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
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Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
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Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
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Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
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Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
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Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
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Pro Ile Ala Leu Ile Cys Gly Phe Asp Pro Thr Ala Asp Ser Leu His  
 35 40 45

Leu Gly His Leu Val Pro Leu Leu Cys Leu Lys Arg Phe Gln Gln Ala  
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Gly His Lys Pro Val Ala Leu Val Gly Gly Ala Thr Gly Leu Ile Gly  
 65 70 75 80

Asp Pro Ser Phe Lys Ala Ala Glu Arg Lys Leu Asn Thr Glu Glu Thr  
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Val Gln Glu Trp Val Asp Lys Ile Arg Lys Gln Val Ala Pro Phe Leu  
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Asp Phe Asp Cys Gly Glu Asn Ser Ala Ile Ala Ala Asn Asn Tyr Asp  
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Trp Phe Gly Asn Met Asn Val Leu Thr Phe Leu Arg Asp Ile Gly Lys  
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His Phe Ser Val Asn Gln Met Ile Asn Lys Glu Ala Val Lys Gln Arg  
 145 150 155 160

Leu Asn Arg Glu Gly Gln Gly Ile Ser Phe Thr Glu Phe Ser Tyr Asn  
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Leu Leu Gln Gly Tyr Gly Met Ala Cys Ala Asn Lys Gln Tyr Gly Val  
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Val Leu Gln Ile Gly Gly Ser Asp Gln Trp Gly Asn Ile Thr Ser Gly  
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Ile Asp Leu Thr Arg Arg Leu His Gln Asn Gln Val Phe Gly Leu Thr  
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Gly Gly Ala Val Trp Leu Asp Pro Lys Lys Thr Ser Pro Tyr Lys Phe  
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Tyr Gln Phe Trp Ile Asn Thr Ala Asp Ala Asp Val Tyr Arg Phe Leu  
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Lys Phe Phe Thr Phe Met Ser Ile Glu Glu Ile Asn Ala Leu Glu Glu  
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Glu Asp Lys Asn Ser Gly Lys Ala Pro Arg Ala Gln Tyr Val Leu Ala  
290 295 300

Glu Gln Val Thr Arg Leu Val His Gly Glu Glu Gly Leu Gln Ala Ala  
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Lys Arg Ile Thr Glu Cys Leu Phe Ser Gly Ser Leu Ser Ala Leu Ser  
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Glu Ala Asp Phe Glu Gln Leu Ala Gln Asp Gly Val Pro Met Val Glu  
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Met Glu Lys Gly Ala Asp Leu Met Gln Ala Leu Val Asp Ser Glu Leu  
355 360 365

Gln Pro Ser Arg Gly Gln Ala Arg Lys Thr Ile Ala Ser Asn Ala Ile  
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Thr Ile Asn Gly Glu Lys Gln Ser Asp Pro Glu Tyr Phe Phe Lys Glu  
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 O-methyl-L-tyrosine, or p-iodo-L-phenylalanine) or tryptophan,  
 tyrosine, or leucine

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